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# Flexibility Options for an Island Energy System

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## What is the challenge?

- High shares of variable renewable energy integrated
- Reliability and security of supply must be ensured
- Supplementary roles of different solutions required

## Potential of biomass CHP?

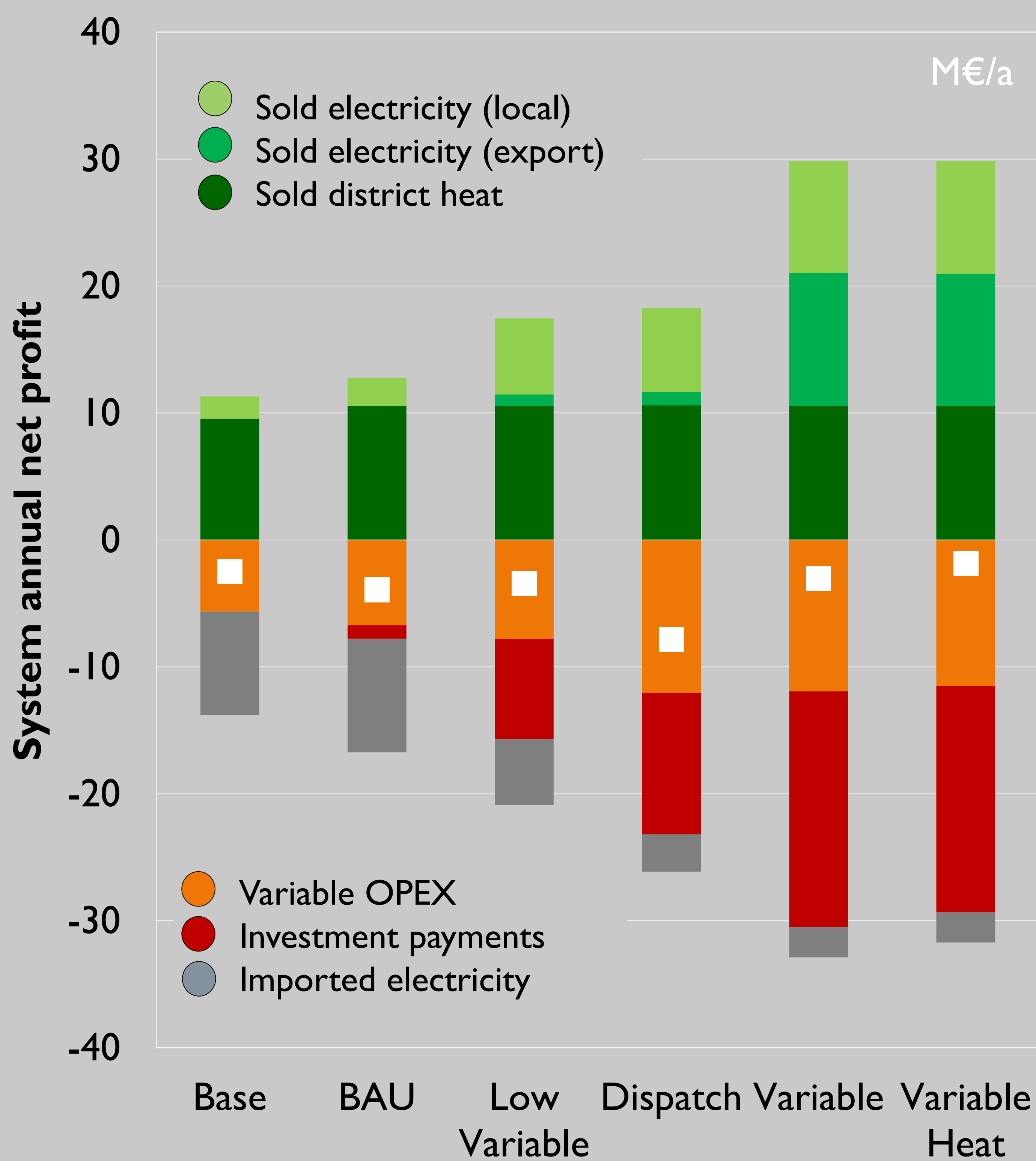
Combined heating and power using biomass fuels enables...

- Dispatchability with low OPEX
- High total efficiency
- Production flexibility with thermal energy storage

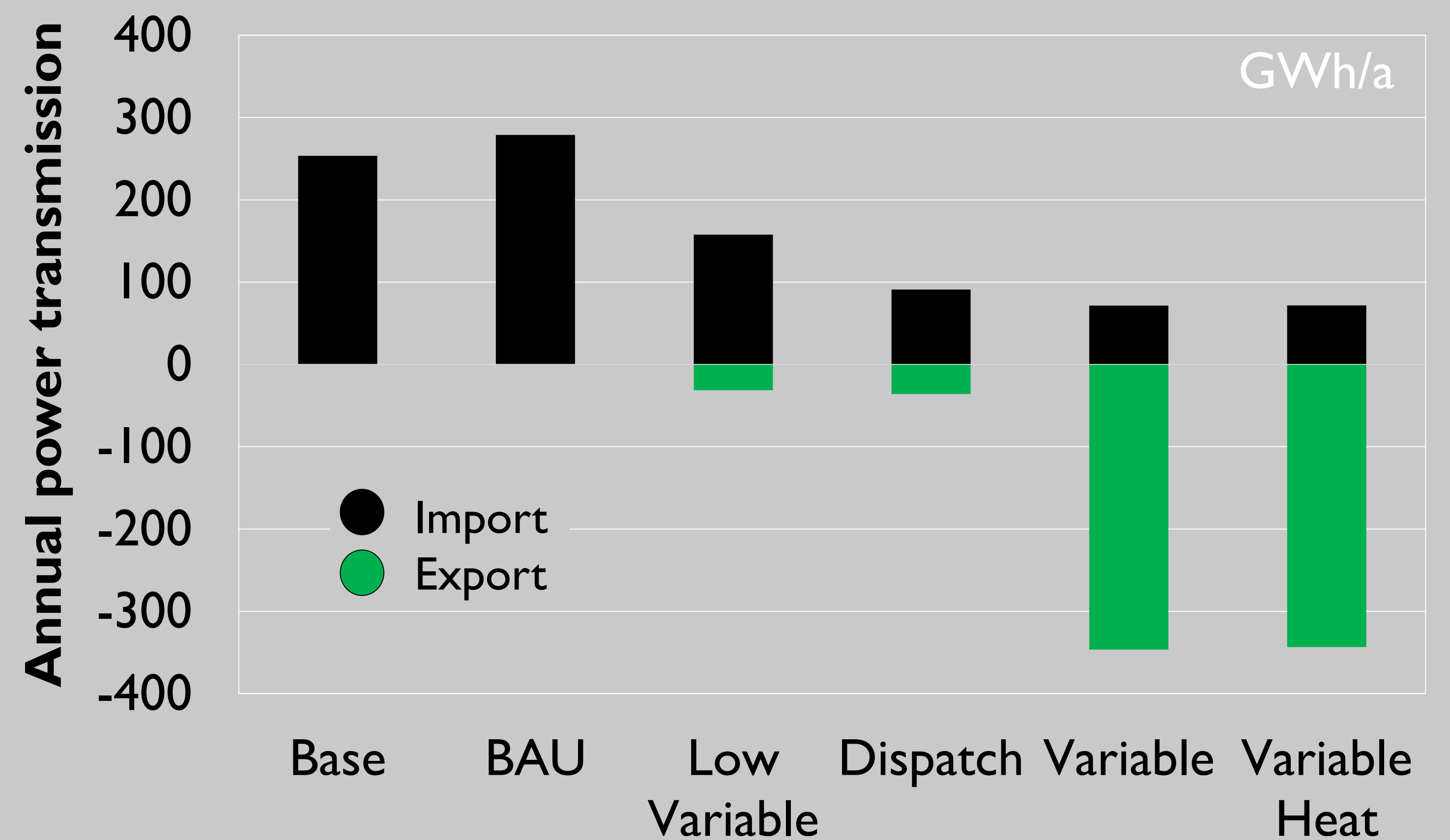
## Focus on Åland Islands

Located between Finland and Sweden, to which power transmission possible

- Large wind projects in progress
- Limited potential for certain PtX solutions such as synthetic transport fuels and biogas upgrading with hydrogen



Scenario & capacity	Wind	CHP	PtHeat	Year
Base	21			2017
BAU	21			2025
Dispatch	85	15		2025
Low Variable	85			2025
Variable	185			2025
Variable Heat	185		15	2025



**We studied the system** using dispatch and investment optimization

- Mixed-integer linear programming
- Hourly simulation of a year
- Detailed unit models
- System total operating costs minimized



**Optimality depends** on the emphasis: costs, self-sufficiency, emission reductions or biomass consumption

- Power-to-heat promising
- Full self-sufficiency not realistic
- Potential for circular economy

